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Realizing models of magnetism with long-range interactions via cavity QED SARANG GOPALAKRISHNAN, Univ. of Illinois at Urbana-Champaign, PAUL GOLDBART, Georgia Inst. of Technology — Optical cavity photons provide a natural channel for mediating long-range interatomic interactions; such interactions are known to drive, e.g., the Dicke phase transition of a BEC in a cavity [1]. In the present work, we consider a general scheme for realizing models of quantum magnetism in which the spin- spin interactions are infinite-ranged. The proposed scheme uses three-level atoms confined in a standing-wave or a ring cavity, with their positions fixed by an external potential; depending on the distribution of atomic positions in the cavity, one can realize models of ferromagnetism, antiferromagnetism, or disordered magnetism, including models that exhibit glassy phases. The models with glassy phases are of particular interest as they are solvable, owing to the infinite range of the interactions, yet exhibit nontrivial properties; such models are, however, impossible to realize in conventional condensed matter. We explore the phase structure of the realizable models, as well as possible experimental probes of the various realizable phases.

[1] K. Baumann et al., Nature 464, 1301 (2010)

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